TEMPRESS®

# Jet Drilling Tool Update

Presentation for

Microhole Technology Integration Meeting

US Department of Energy

Petroleum Technology Transfer Council

August 16, 2006

# Update and Milestones

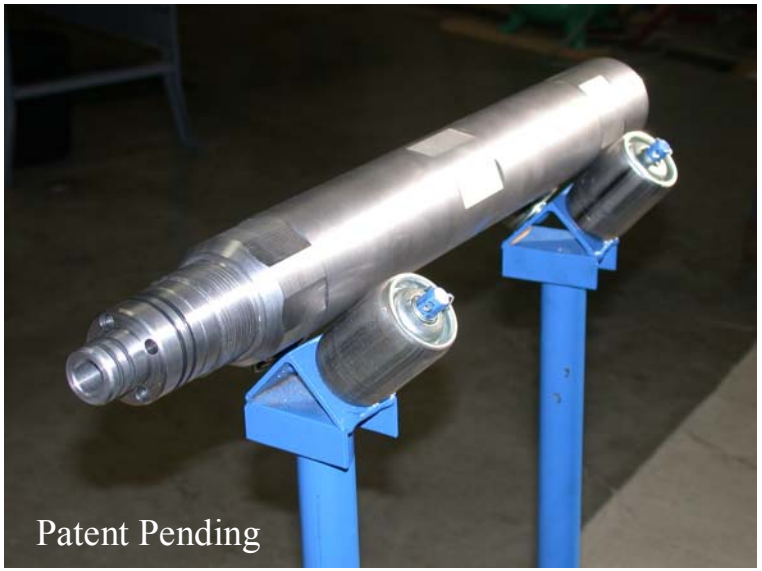
- BHA Configuration
- Features and Benefits
- Current status
- Plans for Future

# Jet Drill BHA Configuration


- 3.625” 8-Jet Drilling head
- 2.75” Jet Rotor (straight-hole configuration shown)
- 2.75” Intensifier
- 2.75” Gas Separator
- 2.75” Screen Sub

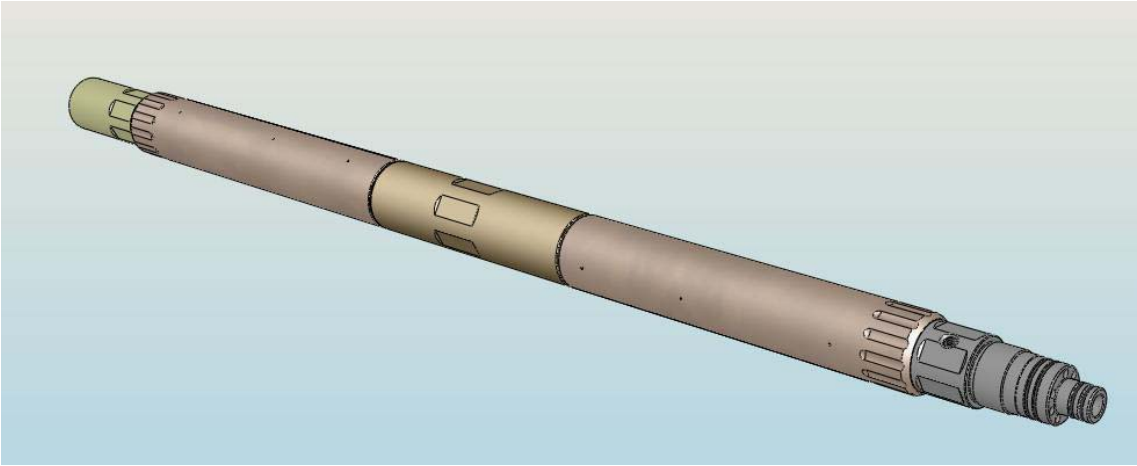
# Compact Gas Separator

- Divides commingled flow into two streams:
  - Water
  - Gas plus left-over water
- Improves jet drilling performance
  - Gas shroud increases jet range
  - Underbalanced jetting prevents formation damage
  - Increased pressure differential at tool
- Two versions:
  - For downhole intensifier
  - For PDM (2-3/8” PAC connection)
- Performance
  - Up to 300 lpm (~80 gpm) water plus 30 scmm (~1000 scfm) nitrogen
  - Less than 1% gas cut in water discharge



# Downhole Intensifier

- Uses energy in separated gassy stream to increase pressure of separated water stream
- Double acting piston/plunger intensifier
- Totally mechanical, self-shifting
- Performance Objective:
  - 35 MPa (~5000 psi) differential input pressure
  - 70 MPa (~10,000 psi) discharge pressure (above ambient)
  - Power output 53 kW (71 hhp)



# Jet Rotor and Drilling Head

- Jet Rotor
  - Conducts separated streams to drilling head
    - » Intensified water to jets
    - » Spent gassy flow to shroud ports
  - Pressure balanced bearings and seals for spinning rotor shaft
  - Integral speed governor
- Drilling Head
  - 8 high-velocity jets
  - Full 3.625” diameter jet coverage
  - Thrust from tangential water jets spins head
  - Gas shroud ports adjacent to each water jet nozzle

Patent Pending

# Jet Drilling Features & Benefits

| *Feature* | *Benefit* |
|---|---|
| Run on standard 2.375” CT | High hydraulic power downhole |
| Underbalanced drilling | ▪ Minimize formation damage<br>▪ Improve cuttings transport<br>▪ Improve jetting performance |
| Relatively short BHA | High build rate directional drilling |
| Very low torque & thrust required | Extended reach horizontal drilling with coiled tubing by reducing tendency for helical buckling |
| Reciprocating intensifier fluidizes lower end of CT and BHA | |
| Spinning high-pressure, gas shrouded jets | 70 MPa (~10,000 psi) jets cut most oil bearing formations |

# Current Status

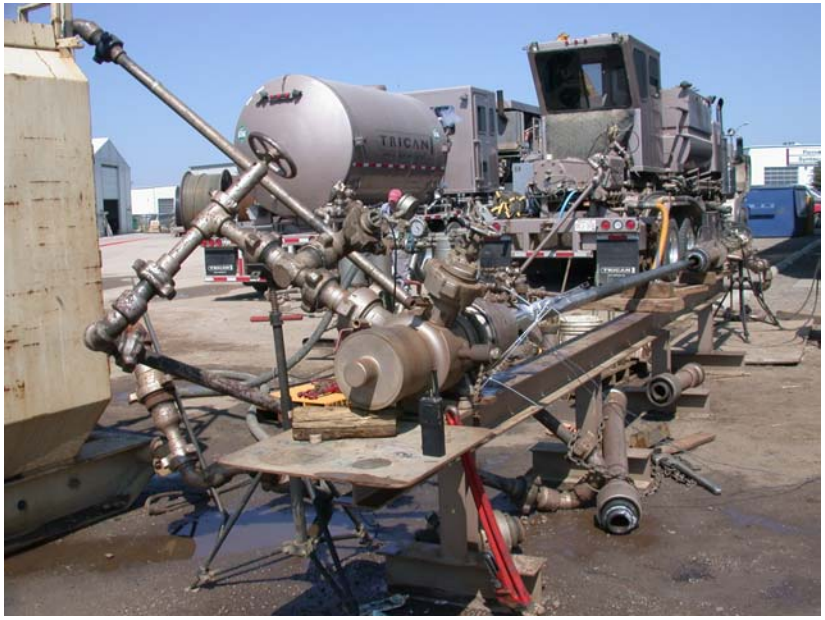
- Currently into Budget Period 2.
- Conducted 2 rounds of testing in downhole simulator
- Tests not yet complete due to part failures after 1 hour of testing
- Problems are identified and enhancements in process
- More yard testing required to demonstrate:
  - Performance
  - Endurance
  - Drilling



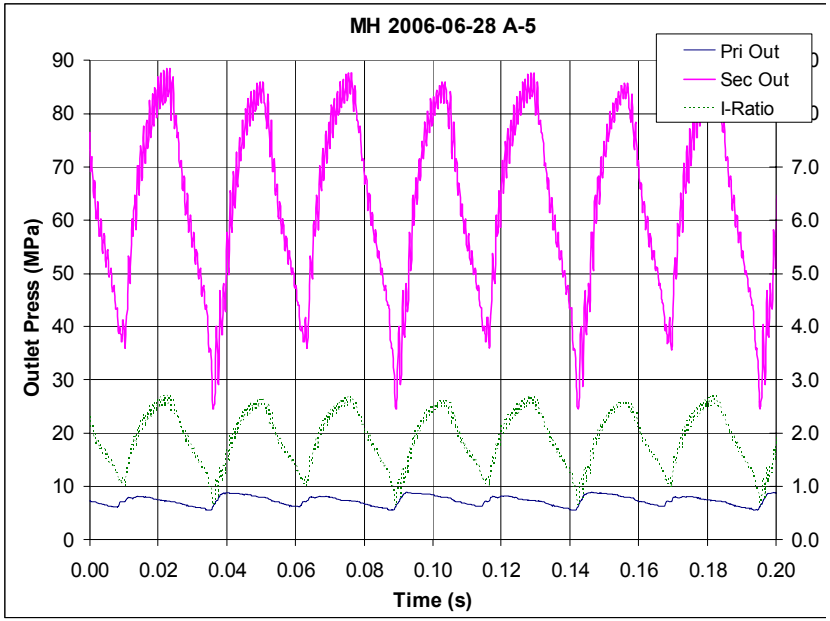
TEMPRESS®

# Test Results

- 85 MPa peak (12,300 psi)/ 60 MPa (8700 psi) median output with 31 MPa (4500 psi) input differential pressure with commingled nitrogen and water
- Power output 53 kW (71 hp)
- Have drilled cement

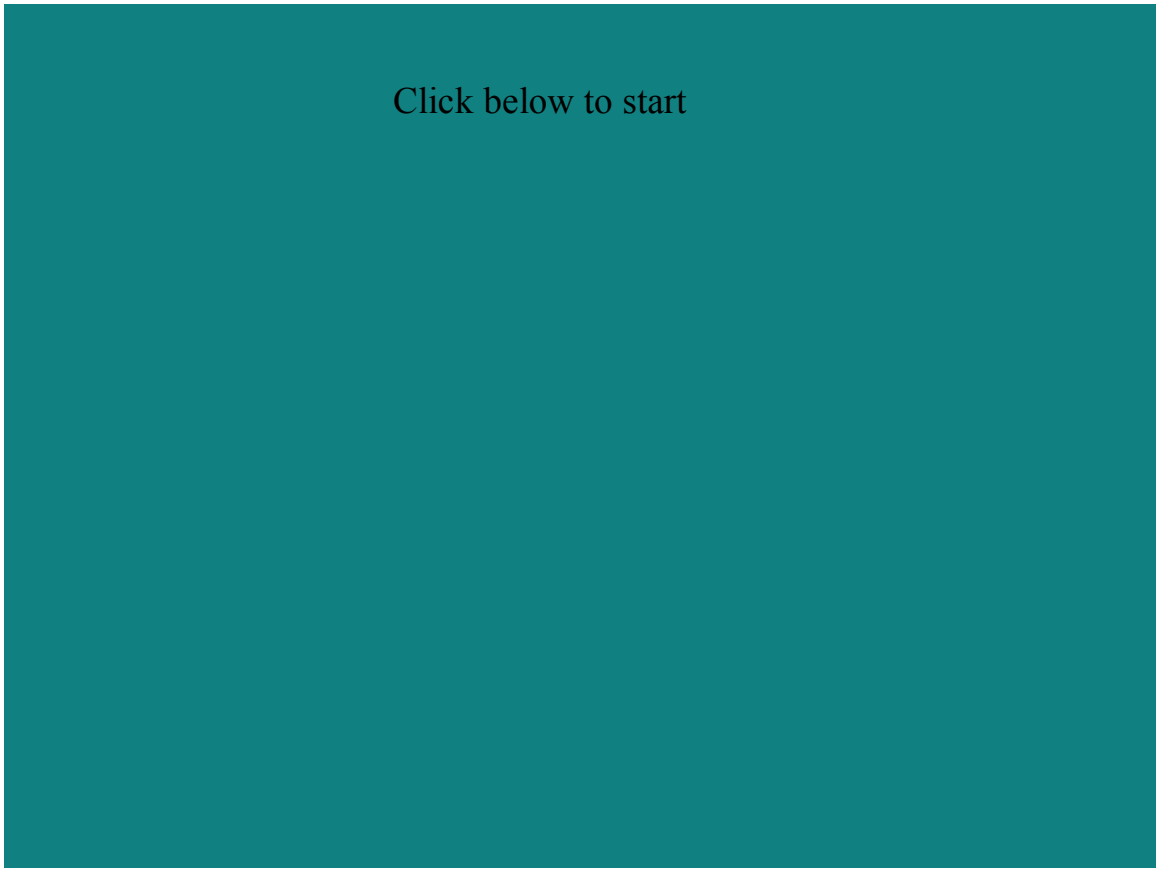


Downhole simulator with nitrogen & water pumps




Sample test data, 36 MPa pump pressure, 5 MPa back (choke) pressure

# Testing (Video)




At Trican Well Services, R&D Facility in Red Deer Alberta, Canada

# Plans for Future

- Additional testing in downhole simulator and/or test well
- Locate field test site
- Field test
- Commercialization Targets:
  - UBD (straight-hole)
  - UBD (directional)
  - Well servicing (scale removal, 4-1/2” to 6” wells)
  - Gas separator for UBD with 2-7/8 to 4-1/2 PDM

# Milestones

| Task Name | 2006 Qtr 2 | 2006 Qtr 3 | 2006 Qtr 4 | 2007 Qtr 1 | 2007 Qtr 2 | 2007 Qtr 3 |
|---|---|---|---|---|---|---|
| **Phase 1 - Prototype Design & Lab Test** | | | | | | |
| **Budget Period One Complete** | | | | | | |
| **Phase 2 - Manufacturing & Prototype Field Test** | | | | | | |
| **Task 8 - Manufacture Prototype Tools** | | | | | | |
| **Preliminary Yard Test** | | | | | | |
| **2.75 Intensifier** | | | | | | |
| **2.75 Jet Rotor & Nozzle Head** | | | | | | |
| **2.75 Gas Separator** | | | | | | |
| **Yard Testing** | | | | | | |
| **Task 9 - Field Testing** | | | | | | |
| **Site Selection** | | | | | | |
| **Mobilization** | | | | | | |
| **Field Test** | | | | | | |
| **Analysis of Results** | | | | | | |
| **Budget Period Two Complete** | | | | | | |
| **Task 10 - Management & Reporting** | | | | | | |